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# FIRST-YEAR EFFECTS OF ROOTRAKING ON AVAILABLE NUTRIENTS IN PIEDMONT PLATEAU SOILS [1/]

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Abstract.--The effects of rootraking on the levels of Ca, Mg, K, $PO_4$ and Na and on infiltration rates in Piedmont Plateau soils were investigated. Soil samples were taken before and after treatments at 10-foot intervals along permanent 100-foot lines located on the ridge, upper slope and lower slopes. Samples were taken at 0-2, 2-4, 4-6, 6-12, 12-18 and 18-24 in. depths and composited. Infiltration rates were measured with a double-ring infiltrometer. There was a general tendency toward nutrient increase at almost all depths with some differences significant at the 5 and 10% levels. A major increase in the $PO_4$ content was found at the 4-6 and 6-12 in depths. Infiltration rates decreased.

Over recent years the use of heavy machinery in forest site preparation has increased. KG blades and rootrakes are now commonly used for windrowing treatments on the rolling sites of the Piedmont Plateau. Of the two treatments, rootraking seems to have the most potential for damaging the soil due to the resulting tillage impact on easily-erodible sites. Drastic decreases in soil nutrients could be counterproductive, offsetting the short-term benefits of these treatments.

The effects of selected site preparation treatments on Piedmont Plateau soils have been investigated by Campbell (1971). In his study, sites were treated with a single chopping, two single choppings or double chopping. No significant differences between treatments were found in available Ca, K or P or in bulk density. Campbell (1973) also tested the effects of harrowing, bedding, and chopping. Bedding increased available Ca, K and P, and harrowing increased Ca and P. Minor increases in Ca were reported with chopping. Chopping had no effect on bulk density while both harrowing and bedding lowered bulk densities. Thus, treatments having a tillage affect increased major nutrients while chopping increased Ca only.

Glass (1976) investigated the effects of rootraking on site quality of Piedmont soils. Soil characteristics and the volume of usable wood produced were compared using a 17-yr old rootraked area and an adjacent broadcast-burned area. Windrows were also compared with the intervening area. Soil texture, nutrient, and organic matter analyses substantiated his observation that the windrows contained not only logging slash and other debris, but also substantial quantities of topsoil. There is no information available on the early effects of rootraking on soil nutrients or infiltration.

We have initiated a 10-yr study, the objective of which is to investigate the effects of rootraking on the fine-textured soils of the Piedmont Plateau.

## Materials and Methods

Study areas were made available by private industry in Georgia. Three of the sites were located in Heard County, and one in each of Talbot and Baldwin Counties. A representative slope was selected for study on each site (Table 1).

The study areas were sampled at the beginning of the experiment and again 3-4 months after treatment. They will be resampled at 2, 3, 4,

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Table 1. Study slope characteristics

| Study area | Soil series | % Slope | Aspect |
|---|---|---|---|
| Heard County: | | | |
| Ricks tract | Cecil | 15 | East |
| Sall Hull tract | Madison | 9 | Northeast |
| Denny tract | Pacolet | 16 | Southeast |
| Talbot County | Vance | 10 | South |
| Baldwin County | Cecil | 12 | South |

6, 8 and 10 years. One hundred-ft lines were established at each study slope on the ridge, upper slope and lower slope. Two points off the study area were permanently marked for each line. Triangulation from these points was used to relocate the original lines after treatment. Soil samples were collected at 10-ft intervals along each 100-ft line (11 points). Samples were taken with a Lord tube sampler at depths of 0-6, 6-12, 12-18 and 18-24 inches. The 0-6 in. sample was subdivided into 0-2, 2-4 and 4-6 in. depths. A hand auger was used when dry conditions made it impossible to use the tube sampler. All samples from a given depth along each line were composited. Samples were air dried and then crushed to pass a 2mm-mesh sieve.

Duplicate, 5-g samples were extracted with a double-acid solution of 0.05 N hydrochloric acid and 0.025 N sulfuric acid (Mehlich 1953). Standard techniques of atomic absorption spectrophotometry were used to determine concentrations of Ca, Mg, K and Na. Phosphate was assayed by the ascorbic acid method (Watonabe and Olsen 1965).

Table 2. Mean values of soil nutrients before (B) and after (A) windrowing treatments in Piedmont soils [1/]

| Depth | $PO_4$ | | Ca | | Mg | | K | | Na | |
|---|---|---|---|---|---|---|---|---|---|---|
| | B | A | B | A | B | A | B | A | B | A |
| (inches) | (parts per million) | | | | | | | | | |
| 0-2 | 1.04 | 1.24 | 365 | 330 | 12.2 | 21.7 | 12.2 | 14.0 | 6.9 | 8.5 |
| 2-4 | 0.40 | 0.68 | 193 | 234 | 8.4 | 9.9 | 7.6 | 8.7 | 5.9 | 8.7 |
| 4-6 | 0.31 | 1.36 | 154 | 222 | 8.2 | 10.7 | 6.8 | 7.5 | 5.3 | 7.5 |
| 6-12 | 0.13 | 0.54 | 173 | 192 | 9.4 | 17.5 | 5.9 | 6.2 | 5.6 | 6.7 |
| 12-18 | 0.16 | 0.46 | 163 | 187 | 10.5 | 13.0 | 5.0 | 4.8 | 5.9 | 6.7 |
| 18-24 | 0.20 | 0.58 | 151 | 166 | 10.4 | 21.1 | 4.6 | 4.5 | 6.0 | 7.7 |

[1/] Two underlines indicate a significant difference at the 5% level and 1 underline, the 10% level.

A double-ring infiltrometer (Haise 1956) was used to measure infiltration on the Talbot County study area. Three infiltration readings were taken at each of the ridge, upper slope and lower slope. Infiltration was measured over a 2-hour period.

## Results and Discussion

Analyses of Variance established that there was no significant effect from slope except at the 18-24 in. depth for Ca ($P < .05$). Thus, data for the slopes were pooled and comparisons between before and after treatments were performed. Table 2 shows mean values for the nutrients tested.

Although not all differences were statistically significant, there was a general tendency after windrowing toward increases for all elements at almost all depths. The $PO_4$ increases were particularly interesting because phospherous is often a limiting factor in growth. At the 4-6 and 6-12 in. depths there were particularly large increases. The increased availability of P at these depths could be beneficial to seedling establishment. However, these results show extremely low P levels at all depths. Due to time of sampling, these differences could be attributed to seasonal changes.

Explanations for these increases would be purely speculative at this time. Possible explanations could include an increase from mineralization, a decrease in plant uptake, and decomposition and mineralization of root materials. This could account for increases even at the lower depths. We are presently analyzing organic matter and N data and these will be reported later.

Mean 2-hr. infiltration rates for each slope before and after rootraking were ridge - 4 and 2 gal, upper slope - 7 and 2 gal, lower slope 17 and 4 gal, respectively. This is interesting in that Campbell (1971) and Grelon (1959) found that site preparation reduced bulk density, thereby increasing infiltration. However, this was not the case in this study.

A decrease in infiltration could be the direct result of the method of site preparation on the study area tested. The company owning the land parked their equipment nightly on the ridge where the upper line was established. The windrow was established so that it ran across the contour of the slope rather than with the contour. Because of this, the windrow intersected the lines on both the upper and lower slopes. Repeated passes were made across these established lines as the tractors moved material to the windrows. This could account for increased compaction, increased bulk density and, therefore, decreased infiltration.

## Summary

Significant increases in available nutrients at the 5 and 10% levels of probability were seen for Mg at the 18-24 in. depth, K at the 0-2 in. depth, P at all depths, and Na at 2-4, 4-6, and 18-24 in. depths. There was a major increase in P at the 4-6 and 6-12 in. depth. There was a general tendency towards increases in all available nutrients tested at almost all depths. Accompanying these changes in nutrient levels, there was decreased infiltration of the soils.

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